

# Physics ATAR - Year 12

## Gravity and Motion Test 1 2018

Name:

Mark:

/ 55

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Teacher:

CJO

JRM

Time Allowed: 50 Minutes

Notes to Students:

1. You must include **all** working to be awarded full marks for a question.
2. Marks will be deducted for incorrect or absent units and answers stated to an incorrect number of significant figures.
3. **No** graphics calculators are permitted – scientific calculators only.

**Question 1****(5 marks)**

A projectile is fired horizontally from a height of 5.00 m with an initial velocity of  $10.0 \text{ ms}^{-1}$ . At the same time, a second projectile is fired horizontally from the same height with a velocity of  $15.0 \text{ ms}^{-1}$ . Calculate the distance the two projectiles are apart when they strike the ground. Ignore any effects of air resistance.

**Question 2****(3 marks)**

A person travelling over the crest of a hill travels in a vertical circular path. Describe what the person would feel as they are at the top of the curve and explain why.

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**Question 3**

**(8 marks)**

A steel ball of mass 2.00 kg is swinging in a circle of radius 0.500 m at a constant speed at the end of a string of length 1.00 m, as shown below.

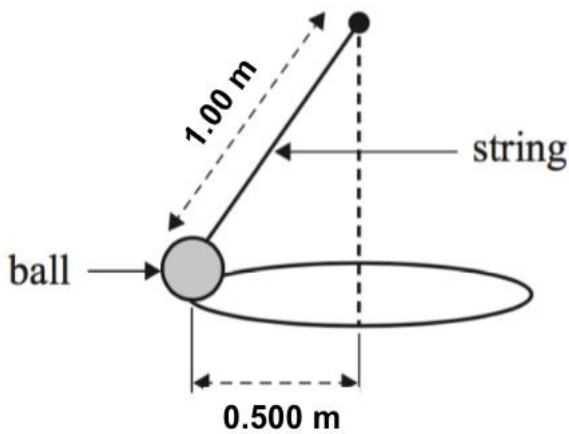


Figure 1.



ball

Figure 2.

- (a) On Figure 2 above, draw all the forces that are acting on the ball.
- (b) Calculate the Tension in the string.

(1 mark)

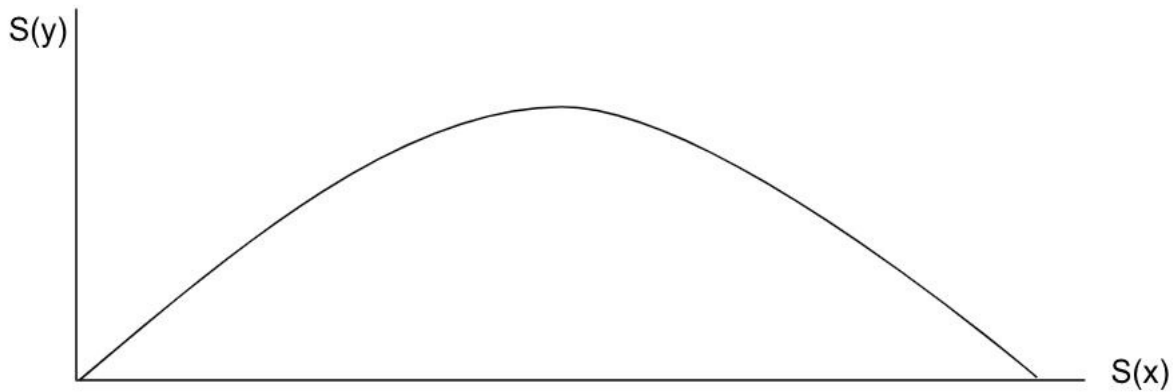
(4 marks)

- (c) Show through calculation that the speed of the ball is  $1.68 \text{ ms}^{-1}$

(3 marks)

**Question 4****(7 marks)**

A ball is projected from the ground at an angle of  $30.0^\circ$  to the horizontal and at a speed of  $40.0 \text{ ms}^{-1}$ , as shown below.



- (a) Calculate the horizontal distance the ball travels before hitting the ground.

**(3 marks)**

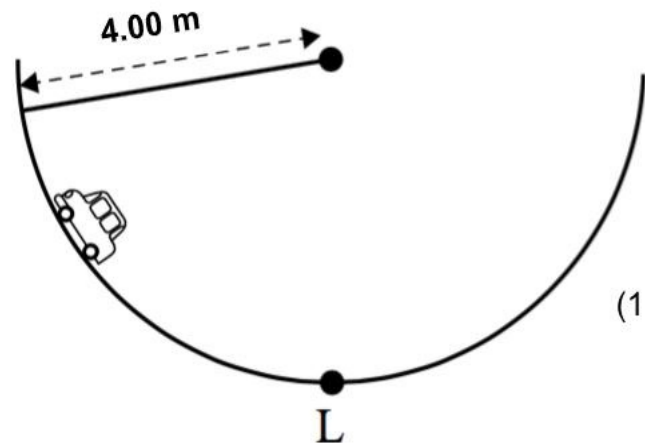
- (b) On the diagram above, sketch the trajectory of the ball if it were to be influenced by the effects of air resistance. **(2 marks)**

- (c) On the axis below, sketch the kinetic energy of the ball as a function of horizontal distance without air resistance. **(2 marks)**



**Question 5****(9 marks)**

A model car of mass 1.20 kg is on a fixed track (that is not free to move or flex) that is part of a vertical circle of radius 4.00 m, as shown below. At the lowest point, L, the car is moving at  $6.00 \text{ ms}^{-1}$ . Ignore friction in this question.



- (a) At the lowest point, L, draw the forces that would be acting on the car.

(1 mark)

- (b) Calculate the magnitude of the force exerted by car on track at its lowest point, L.

(4 mark)

- (c) Using energy considerations, calculate the maximum vertical height that the car rises to.

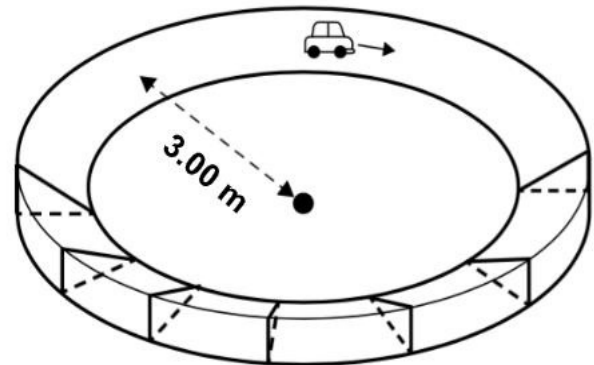
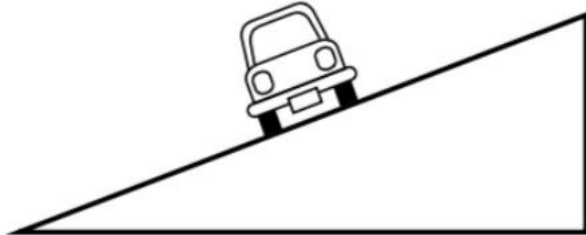
(4 marks)

**Question 6****(8 marks)**

A model car of mass  $2.00\text{ kg}$  is placed on a banked circular track. The car follows a path of radius  $3.00\text{ m}$ . The motor maintains a constant speed of  $2.00\text{ ms}^{-1}$ , as shown in the diagram. The angle of bank is such that there are no sideways frictional forces between the wheels and the track.

- (a) On the diagram below, draw all the forces acting on the car using solid lines and label each force.

(1 mark)



- (b) Calculate the required angle of bank of the track to maintain the car's circular path.

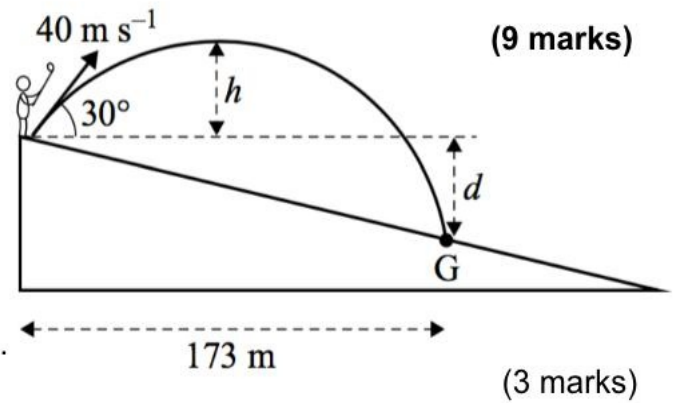
(4 marks)

- (c) If the car reduces its speed, explain, with the aid of a vector diagram, how friction between the wheels and the track would need to act in order to maintain its horizontal circular motion.

(3 marks)

**Question 7**

A golfer hits a ball on a part of a golf course that is sloping downwards away from him, as shown in the diagram. He strikes the ball at  $30.0^\circ$  above the horizontal with a speed of  $40.0 \text{ m s}^{-1}$



- (a) Ignoring air resistance, calculate the maximum height the ball raises above its original position.

- (b) The ball lands at a point at a horizontal distance of 173 m from the hitting-off point, as shown above. Calculate the vertical drop,  $d$ , from the hitting-off point to the landing point, G.
- (3 marks)

- (b) Calculate the velocity of the ball upon impact at point, G.

(3 marks)

**Question 8****(6 marks)**

A javelin thrower is told that the angle to throw a javelin to achieve the greatest horizontal distance is  $45.0^\circ$  to the horizontal. She suspects that she can throw faster at lower angles and therefore achieve a greater distance. When throwing a javelin at  $45.0^\circ$ , she can achieve a horizontal distance of approximately 64.0 m. This is an initial velocity of  $25.0 \text{ ms}^{-1}$ . If she can throw fastest at an angle of  $33.0^\circ$ , what velocity is required at this angle to exceed a distance of 64.0 m?

**END OF TEST**